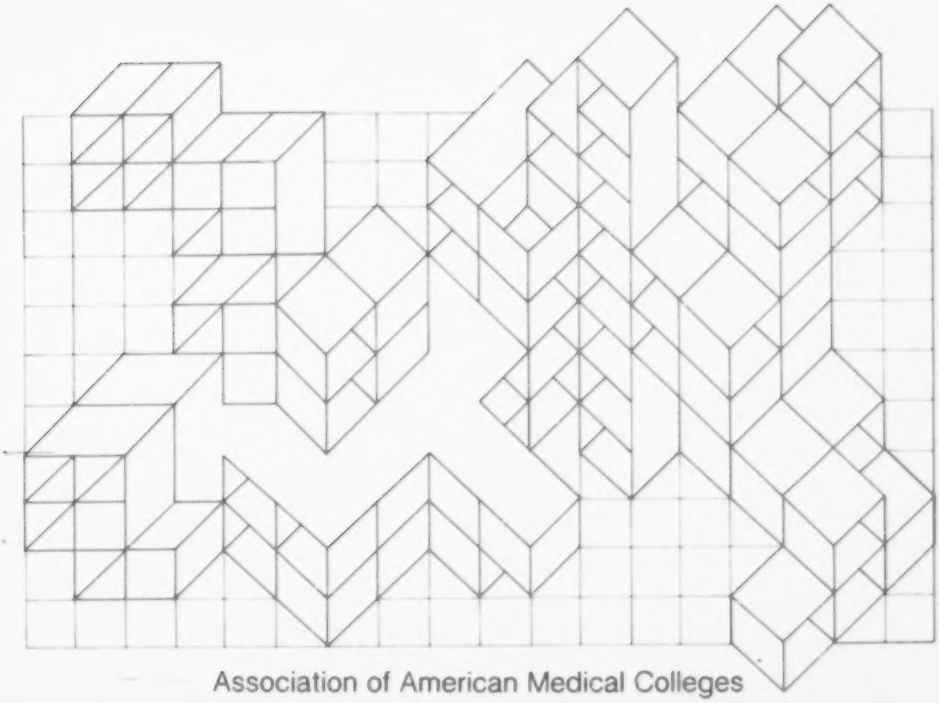
Vol. 59 No. 11 November 1984 Part 2

JOURNAL OF

Medical Education

Physicians for the Twenty-First Century



Association of American Medical Colleges

Contents

Members of the Project Panel on the General Professional Education of the Physician and College Preparation for Medicine and Members of the Project Staff vii

Introduction
Steven Muller 1

Conclusion 1
Purposes of a General Professional Education 5

Conclusion 2
Baccalaureate Education 7

Conclusion 3
Acquiring Learning Skills 11

Conclusion 4
Clinical Education 15

Conclusion 5
Enhancing Faculty Involvement 19

Other Important Considerations 23

Afterword
John A. D. Cooper 29

Appendixes

Medical Education in the United States and Canada
August G. Swanson 35

Exhibit 1: Emerging Perspectives on the General Professional Education of the Physician 57

Exhibit 2: Participants in the Project 75

Exhibit 3: Charges to Working Groups 81

Reports of the Project Working Groups and Subgroups

Report of the Working Group on Essential Knowledge 109

Report of the Working Group on Fundamental Skills 125

Subgroup Report on Clinical Skills
Harold C. Sox, Jr., William L. Morgan, Jr., Victor R. Neufeld, George F. Sheldon, and Xenia Tonesk 139

Subgroup Report on Learning Skills
Alan B. Knox, Emanuel Suter, and JW Carmichael, Jr. 149

Subgroup Report on Medical Information Science Skills
Nina Matheson and Donald A. B. Lindberg 155

Subroup Report on Critical Appraisal Skills: The Application of the Scientific Method
Victor R. Neufeld, Robert E. Olson, Donald A. B. Lindberg, and M. Louis van de Beek 161

Subgroup Report on Teamwork Skills
John P. Geyman and James A. Deyrup 169

Subgroup Report on Personal Management Skills
Thomas L. Pearce and George F. Sheldon 173

Report of the Working Group on Personal Qualities, Values, and Attitudes . 177

Report of the Louis Harris and Associates Survey on the Status of Medical Education 193

Index

Index 201

Medical Education in the United States and Canada

August G. Swanson, M.D.

Many comprehensive reports of American medical education have appeared since the 1910 landmark work by Abraham Flexner (1). From them one can gain insights into the evolution of U.S. and Canadian medical education and the institutions engaged in biomedical education and research (2–14).

To provide the framework for the special reports that emanated from the efforts of the Project on the General Professional Education of the Physician and College Preparation for Medicine, a comprehensive description of medical education has been developed. This includes information on U.S. and Canadian medical schools, applicants and students, curricula, scheduling of time, and grading. Some comments about career plans of 1983 graduates from U.S. medical schools and students' perceptions of their education conclude the narrative. Data are drawn from sources developed by the Association of American Medical Colleges and the Association of Canadian Medical Colleges (15–20).

The Medical Schools

There are a total of 143 medical schools in the United States and Canada (tables 1 and 2). In 1983–84, 127 medical schools in the United States had students enrolled, although two were so new they had not yet graduated their first classes. In contrast, three of the U.S. schools were founded in the late 1700s: the University of Pennsylvania School of Medicine in 1765, Harvard Medical School in 1782, and Dartmouth Medical School in 1797. Almost one third—41—of all medical schools in the United States came into existence in the past quarter century (16). Seventy-five of the 127 U.S. schools are publicly owned. Of the 52 medical schools that are privately owned, 35 receive financial assistance from the states in which they are located (21). The medical schools tend to be concentrated in the populous states; New York has the largest number with 12, and California follows with eight. Five states have no schools.

The 16 medical schools in Canada are all publicly owned and supported. They also are found in the more populous provinces in the eastern part of the continent. Ontario has five medical schools, five provinces have only one school, and four provinces have no medical schools. The first Canadian medical school established was the McGill University Faculty of Medicine in Montreal, Quebec, in 1829. Four of the 16 schools were founded in the last quarter century (16).

The number of full-time faculty members ranges from over 2,000 to fewer than 100. They are responsible for the education of medical students, residents, graduate students in the basic sciences, and clinical fellows (Table 3). Medical student enrollments vary from over 1,300 to

Dr. Swanson was *project director*, Project on the General Professional Education of the Physician and College Preparation for Medicine, and is *director*, Department of Academic Affairs, Association of American Medical Colleges.

fewer than 100. In both the United States and Canada, however, the total number of residents, graduate students, and fellows is larger than the total number of medical students enrolled.

Medical faculties are also engaged in research and patient care. Table 4 shows the sources of financial support for U.S. medical schools in 1981–82. Federal research support from grants and contracts and income derived from medical services constituted 57 percent of the total support of activities in U.S. medical schools.

The involvement of faculties in research varies from institution to institution. In the United States, 20 medical schools had research expenditures of $20 million or more in 1981–82; 17 had research expenditures between $10 and $20 million; and 86 expended less than $10 million on research programs. The range was from $50.6 million to $11,600. Three Canadian schools expended over $20 million on research; seven between $10 and $20 million; and six less than $10 million. The range was from $28.9 to $3.1 million (Table 5).

Teaching hospitals are vital components of academic medical centers. The principal teaching hospitals in the United States are members of the Association of American Medical Colleges' Council of Teaching Hospitals (COTH). In 1980 the 327 nonfederal members of COTH made up 5.8 percent of all hospitals in the United States. These hospitals provided 20 percent of the acute patient care days and 30 percent of outpatient visits in the country. In combination with 74 Veterans Administration hospital members of COTH, teaching hospitals provided 75 percent of the graduate medical education positions in the United States. Medical student education is principally provided by these hospitals, all of which are either owned by or affiliated with a medical school (17, 18).

Applicants and Matriculants

Data on applicants and matriculants to U.S. medical schools are reported for the first-year new entrants to the class of 1983–84 and to Canadian medical schools for the first-year new entrants to the class of 1982–83 (19, 20).

A total of 35,200 individuals filed 319,340 applications—an average of nine applications each—for the 16,480 places to be filled by new entrants to U.S. medical schools in 1983–84. Of these applicants, 48.9 percent were accepted for admission. The acceptance rate for men applicants was 49.8 percent, and for women applicants it was 47.1 percent. Thirty-four percent of the applicants were women, and they filled 32.6 percent of the new places available (5,370). Forty-seven percent of all applicants were enrolled. Black Americans, American Indians, Mexican Americans, and Mainland Puerto Ricans represented 9.6 percent of the first-year class. Approximately 42 percent of these entrants were women. The predominant age group of the 1983 entering class was 21 to 23 (64 percent). Four percent were 20 years of age or younger, and 32 percent were 24 or older.

A total of 7,720 persons filed 19,587 applications—an average of 2.5 applications each—for the 1,931 places to be filled by new entrants to Canadian medical schools in 1982–83. Of these applicants, 25 percent were accepted for admission and enrolled. Men constituted 57 percent of the applicant pool and women 43 percent. The acceptance rate for men applicants was 24.4 percent, and for women applicants it was 25.8 percent.

The college majors of all applicants to U.S. medical schools and those accepted for admission in 1983 are shown in Table

6. Majors in the biological sciences predominated with 45 percent of the applicants and 42 percent of those accepted having majors in this area. The physical sciences were the next largest group at 23 percent and 26 percent, respectively. Nonscience majors comprised 10 percent of the applicants and 10 percent of those accepted. Four percent of the applicants had majors in nursing, pharmacy, and other health professions; three percent were accepted.

The academic records of those accepted to enter the U.S. 1983–84 class were high (Table 7). The overall grade point average of 76 percent of those accepted was 3.30 or higher on a scale of 0 to 4. Almost three of every four applicants accepted for admission (74 percent) had grade point averages in the 3.30 to 3.99 range.

Applicants with higher scores on the Medical College Admission Test had a distinct advantage. Of the 17,311 U.S. applicants with grade point averages in the 3.30 to 3.99 range, 72 to 76 percent of those with Medical College Admission Test subtest scores of 8 to 15 were accepted. Only 31 to 46 percent of the applicants in the same grade point average range with Medical College Admission Test subtest scores of 1 to 7 were admitted (19).

During the years 1981, 1982, and 1983, 839 colleges and universities supplied an average of at least five applicants to U.S. medical schools (Table 8). One half of the applicants came from 104 institutions that provided between 86 and 519 applicants each. The remaining half came from 1,591 other colleges and universities, and 1,063 supplied nine or fewer. Accordingly, students in the entering classes of most medical schools in the United States come from a large number of colleges and universities. In 1983, members of the average entering class came from 51 different institutions. The range was from seven to 105 (Table 9).

The Curricula

In all except two schools the general professional education of medical students is a four-year program. The University of Calgary Faculty of Medicine, Calgary, Alberta, and McMaster University School of Medicine, Hamilton, Ontario, have three-year curricula. In general, four-year curricula are divided into a preclinical phase, occupying the first two years, and a clinical phase in the last two years. The preclinical phase is predominantly devoted to study of the major disciplines in the sciences basic to medicine: anatomy, pathology, physiology, microbiology, biochemistry, pharmacology, and human behavior. During the clinical phase, students are assigned to the clinical services of teaching hospitals for required clerkships in the major clinical disciplines: internal medicine, surgery, pediatrics, obstetrics/gynecology, psychiatry, and, in some schools, family medicine. Subsequent to completing their required clerkships, students have varying periods of time for elective courses and clerkships during their final year.

PRECLINICAL CURRICULA

There are four patterns of preclinical instruction.

Disciplinary—Each basic science department has the responsibility for teaching a course in its discipline. Fifty-six percent of the schools have this pattern of instruction.

Disciplinary with a correlative course—The basic sciences are taught by each department, but in the second year, a major interdisciplinary course involving both basic and clinical disciplines provides correlations between basic science concepts and principles and the manifes-

tations of disease. Thirty-five percent of the schools use this pattern.

Systems—At nine percent of the schools the curriculum is organized around body organ systems. Interdisciplinary groups of basic scientists and clinicians work together in planning and teaching courses about each organ system. At some of these schools the sequence of organ system courses is preceded by a brief sequence of introductory basic science courses.

Problem-based—A problem-based approach to teaching and learning is used to varying degrees at four schools. In one school, the entire preclinical curriculum is taught using this method with students in small groups. Clinically based problems are presented to students who are required to seek out information and take primary responsibility for formulating solutions themselves under the guidance of a mentor.

The length of time allocated to instruction during the preclinical phase varies from 41 to 115 weeks (Table 10). The average is 74 weeks. Twenty-five to 30 hours a week of the medical students' time is usually scheduled. Although at some schools as few as 15 to 20 hours a week are scheduled, at others students have scheduled activities for as many as 35 to 38 hours a week. These variations in the number of weeks and in the intensity of weekly scheduling are reflected in the variability of total instructional hours in preclinical curricula, which range from 1,028 to 2,430 hours (Table 11).

The lecture is the predominant method of instruction (Table 11). In medical schools in the United States and Canada the number of lecture hours ranges from 468 to 1,639. The proportion of total scheduled time devoted to lectures varies from 36 to 78 percent (Table 12). In addition to this, in most schools conference hours are scheduled, and some of this time may be used for additional lectures (Table 11).

The number of hours scheduled for laboratory work and the proportion of total hours devoted to laboratories is as low as 68, four percent of scheduled time, to as high as 834, 44 percent of scheduled time (Tables 11 and 12). Laboratory time is greatest in schools with disciplinary curricula, and the two disciplines with the largest proportion of laboratory time are anatomy and pathology. Of the basic sciences, biochemistry has the least emphasis on laboratory work. Only 45 schools incorporate laboratory work into their biochemistry courses.

The distribution of scheduled time among disciplines is shown in Table 13. Estimates of time distribution are derived from an analysis of the *1983–84 AAMC Curriculum Directory*. For 109 to 115 schools the time allotted to the seven major preclinical disciplines can be estimated. For the remaining 34 schools, course titles do not identify clearly which disciplines are involved. This is particularly true for schools with organ-system-based curricula.

Anatomy—Includes gross anatomy, histology, embryology, and, in some cases, neuroanatomy. At those schools with neuroscience courses, neuroanatomy is subsumed in that course. An average of 350 hours is scheduled for anatomy. The range is from 135 to 612.

Pathology—Includes anatomic and, in some cases, clinical pathology. At some schools there is a separate course in laboratory diagnosis. On average, 233 hours are scheduled for pathology. The range is from 105 to 418.

Physiology—On average, 167 hours are scheduled for physiology. The range is from 90 to 341. At schools with neuroscience courses and at schools with organ

system pathophysiology courses in the second year, there are fewer scheduled hours in physiology.

Microbiology—Includes microbiology, immunology, infectious diseases, and parasitology. On average, 155 hours are scheduled for microbiology. The range is from 66 to 291.

Biochemistry—On average, 137 hours are scheduled for biochemistry. The range is from 55 to 272.

Pharmacology—On average, 129 hours are scheduled for pharmacology. The range is from 50 to 240.

Neurosciences—Not all schools have a specific course in the neurosciences. On average, the 75 schools that have a course in the neurosciences schedule 109 hours. The range is from 18 to 210 hours.

Behavioral sciences—Includes human behavior and psychiatry. The 105 schools with a course in behavioral sciences on average schedule 91 hours. The range is from 20 to 223.

Preventive medicine-epidemiology—Includes community medicine and biostatistics. There are 83 schools that schedule 51 hours on average in these disciplines. The range is from eight to 198.

Genetics—There are 65 schools with a separate genetics course. On average, 27 hours are scheduled for genetics. The range is from five to 69 hours.

In addition to studies in the seven major areas, all schools provide a course usually titled "Introduction to Clinical Medicine" during the preclinical phase. The purpose of this course is to provide students with an opportunity to develop sufficient clinical skills to begin their work with patients in their third-year clerkships. At 71 schools, the students' initial experience in interviewing and examining patients occurs in their first year, and in the second year additional time is allocated for this purpose. The intensity of exposure to patients during the first year varies. At 27 schools, between 100 and 200 hours of the first-year program are scheduled for this introductory experience. At 19 schools, 50 to 100 hours are scheduled, and 25 schools schedule fewer than 50 hours. At the remaining schools, direct experience in interviewing and examining patients is reserved for the second year (15).

The time available for elective courses during the preclinical curriculum is generally quite restricted. Table 14 reveals that relatively few students take electives in the basic sciences.

In summary, the preclinical curricula in U.S. and Canadian medical schools are predominantly devoted to seven basic sciences. The lecture is the principal method of instruction. At some schools lectures occupy over 70 percent of scheduled time. Anatomy and pathology, on average, use 46 percent of the time scheduled for instruction in the seven major basic science disciplines.

CLINICAL CURRICULA

The clinical curricula of U.S. and Canadian medical schools are divided into blocks of time for clerkships in the major clinical disciplines. Students are assigned to the clinical services of teaching hospitals for periods varying from one week to 12 weeks. Clerkships are required in medicine, surgery, pediatrics, obstetrics/gynecology, and psychiatry at all schools. Family medicine is required at 56 schools, and neurology at 64. Table 15 shows the number of weeks of required clerkships in these disciplines at the schools whose entries in the *1983–84 AAMC Curriculum Directory* permit an analysis of the distribution of time among clerkships.

In addition to these major clerkships, some schools require clerkships in other specialties. Twenty-seven schools require

one to four weeks in anesthesiology (average is two). At 10 schools one to four weeks of dermatology are required (average is two). At 16 schools a clerkship in radiology ranging from one to four weeks is required (average is three). Seven schools require one to four weeks in physical medicine and rehabilitation (average is two), and 20 schools require one to eight weeks in community medicine (average is four).

A clerkship designated as primary care is required in 21 schools. These clerkships vary from two to 12 weeks (average is six). A subinternship of four to eight weeks in one of the major specialties is required by 16 schools (average is six). Eight schools provide a period of two to 12 weeks during their clinical curricula for seminars in the basic sciences. At one school an entire academic year is devoted to electives in the basic sciences following a year of required clerkships.

Required clerkships are principally scheduled for the third-year of medical school. Many schools combine the last two years into one academic period. After completing their required clerkships, students have varying periods of time for electives (Table 16). Each student may schedule the elective period according to his or her interest, or the student may be required to select some electives from a number of designated specialties. Over 60 percent of students take electives in cardiology and radiology. Emergency medicine, the choice of 41 percent of the students, is the next most popular (Table 17).

Grading and Evaluation

Approximately one half of all U.S. medical schools use the honors/pass/fail form of grading (Table 18). Twenty-one schools use a pass/fail system for basic sciences, 17 for clinical clerkships, and 38 for electives. Letter or number grades (usually A, B, C, D, and F) are used at the remainder of the schools.

In basic science courses, students are principally evaluated by the use of written examinations. In clinical clerkships, evaluations are based both on written examinations and on the judgment of faculty and residents who have supervised the students.

Parts I and II of the certification sequence of the National Board of Medical Examiners are used by many U.S. schools for both student and course evaluation (Table 19). Part I is optional at only 29 schools. At the remainder of the schools, students must take the examination. At 62 schools, Part I must be passed for promotion or graduation. Taking Part II is optional at 36 schools. At 48 schools, students are required to pass Part II of the examination to graduate.

Career Plans of Graduates

After graduation from medical school, students undertake three or more years of education and training in a specialty. About three quarters of the U.S. graduating seniors who responded to the AAMC's Graduation Questionnaire in 1983 indicated that they had definitely decided to be certified in a specialty (Table 20). The largest proportion (50.7 percent) of 1983 graduates planned careers in nonsurgical specialties that will involve them in direct patient care. Almost a third (31.6 percent) planned to become certified in a surgical specialty. The balance, 17.6 percent, planned to be specialists who usually practice in a hospital and provide supportive diagnostic and therapeutic services to physicians and their patients.

Table 21 shows the careers planned at the time of graduation by the 10,399 respondents to the questionnaire who answered the question. Almost one fourth (24.6 percent) aspire to full-time aca-

demic appointments. Close to two thirds (61.7 percent) planned to enter private clinical practice, and 12.8 percent planned careers in salaried clinical positions.

Students' Perceptions of Their Education

Graduating seniors were asked about whether they believed the time devoted to selected areas of their education was excessive, appropriate, or inadequate. More than one third of the 1983 graduates believed that the time devoted was inadequate in 12 of 21 selected areas (Table 22). Between 35 and 50 percent believed there was inadequate time devoted to the management of patients' socioeconomic, educational, and emotional problems; patient follow-up; care of ambulatory patients; care of elderly patients; public health and community medicine; medical record-keeping; and self-evaluation and independent learning. One half to two thirds believed that inadequate time was devoted to research techniques, preventive care, nutrition, practice management, and medical care cost control.

References

1. FLEXNER, A. *Medical Education in the United States and Canada: A Report to the Carnegie Foundation for the Advancement of Teaching.* Bulletin No. 4. Boston, Massachusetts: Updyke, 1910.
2. ASHFORD, M. (Ed.). *Trends in Medical Education.* The New York Academy of Medicine Institute on Medical Education. New York: The Commonwealth Fund, 1947.
3. BECKER, H. S., GEER, B., HUGHES, E. C., and STRAUSS, A. L. *Boys in White: Student Culture in Medical School.* Chicago, Illinois: University of Chicago Press, 1961.
4. BORDLEY, J., III, and HARVEY, A. M. *Two Centuries of American Medicine, 1776–1976.* Philadelphia, Pennsylvania: W.B. Saunders, 1976.
5. BOWERS, J. Z., and PURCELL, E. F. *Advances in American Medicine: Essays at the Bicentennial, Volume I.* New York: Josiah Macy, Jr. Foundation, 1976.
6. BOWERS, J. Z., and PURCELL, E. F. *Advances in American Medicine: Essays at the Bicentennial, Volume II.* New York: Josiah Macy, Jr. Foundation, 1976.
7. COGGESHALL, L. T. *Planning for Medical Progress Through Education.* Evanston, Illinois: Association of American Medical Colleges, 1965.
8. Council on Medical Education, The House of Delegates of the American Medical Association. *Future Directions for Medical Education.* Chicago, Illinois: American Medical Association, 1982.
9. DEITRICK, J. E., and BERSON, R. C. *Medical Schools in the United States at Mid-Century.* New York: McGraw-Hill, 1953.
10. HUBBARD, W. N., JR., GRONVALL, J. A., and DEMUTH, G. R. (Eds.). The Medical School Curriculum. *J. Med. Educ.*, **45**:Part 2, 1970.
11. JOHNSON, D. G. *Physicians in the Making: Personal, Academic, and Socio-economic Characteristics of Medical Students from 1950 to 2000.* San Francisco, California: Jossey-Bass, 1983.
12. PAGE, R. G., and LITTLEMEYER, M. H. (Eds.). *Preparation for the Study of Medicine.* Chicago, Illinois: University of Chicago Press, 1969.
13. RAPPLEYE, W. C. (Director). *Medical Education: Final Report of the Commission on Medical Education.* New York: Association of American Medical Colleges Commission on Medical Education, 1932.
14. STARR, P. *The Social Transformation of American Medicine.* New York: Basic Books, 1982.
15. Association of American Medical Colleges. *1983–84 AAMC Curriculum Directory.* Washington, D.C.: Association of American Medical Colleges, 1983.
16. Association of American Medical Colleges. *AAMC Directory of American Medical Education, 1983–84.* Washington, D.C.: Association of American Medical Colleges, 1983.
17. Association of American Medical Colleges. *A Description of Teaching Hospital Characteristics.* Washington, D.C.: Association of American Medical Colleges, 1982.
18. Association of American Medical Colleges. *Medical Education: Institutions,*

Characteristics, and Programs—A Background Paper. Washington, D.C.: Association of American Medical Colleges, 1983.

19. Association of American Medical Colleges. *Medical School Admission Requirements, 1985–86, United States and Canada*. Washington, D.C.: Association of American Medical Colleges, 1984.
20. Association of Canadian Medical Colleges. *Canadian Medical Education Statistics*. Ottawa, Ontario, Canada: Association of Canadian Medical Colleges, 1983.
21. 83rd Annual Report on Medical Education in the U.S., 1982–83. *J.A.M.A.*, **250**:1526, 1983.

TABLE 1

Number of Faculty Members, Students, and Graduates in 127 U.S. Medical Schools, 1982–83

School	No. of Full-Time Faculty Members			No. of Medical Students Enrolled	No. of 1983 Graduates
	Basic Science	Clinical Science	Total		
Alabama					
Alabama	205	534	739	660	165
South Alabama	62	87	149	270	71
Arizona					
Arizona	91	257	348	356	81
Arkansas					
Arkansas	82	215	297	546	129
California					
California/Davis	57	196	253	392	87
California/Irvine	64	233	297	394	95
California/Los Angeles	139	667	806	679	166
California/San Diego	46	359	405	504	119
California/San Francisco	131	580	711	638	151
Loma Linda	88	443	531	563	137
Southern California	132	724	856	585	146
Stanford	77	317	394	405	91
Colorado					
Colorado	118	382	500	518	121
Connecticut					
Connecticut	121	306	427	340	84
Yale	117	460	577	460	98
District of Columbia					
Georgetown	82	360	442	817	201
George Washington	77	207	284	613	151
Howard	95	183	278	500	117
Florida					
Florida	118	321	439	466	112
Miami	151	498	649	631	178
South Florida	49	114	163	294	8
Georgia					
Emory	87	503	590	479	116
Medical College of Georgia	111	297	408	725	180
Mercer	16	19	35	24	0*
Morehouse	25	11	36	79	0*
Hawaii					
Hawaii	73	48	121	274	63
Illinois					
Chicago Medical	63	167	230	634	148
Chicago/Pritzker	130	299	429	431	114
Illinois	152	298	450	1,357	338
Loyola/Stritch	68	185	253	438	36
Northwestern	129	259	388	701	181
Rush	77	209	286	517	124
Southern Illinois	104	126	230	236	73

* First class not yet graduated.

TABLE 1—(Continued)

School	No. of Full-Time Faculty Members			No. of Medical Students Enrolled	No. of 1983 Graduates
	Basic Science	Clinical Science	Total		
Indiana					
Indiana	236	317	553	1,199	275
Iowa					
Iowa	126	386	512	707	175
Kansas					
Kansas	112	281	393	815	191
Kentucky					
Kentucky	85	229	314	419	101
Louisville	87	231	318	547	137
Louisiana					
Louisiana/New Orleans	161	324	485	727	173
Louisiana/Shreveport	56	102	158	403	99
Tulane	78	235	313	602	150
Maryland					
Johns Hopkins	142	610	752	481	121
Maryland	113	310	423	709	172
Uniformed Services	157	551	708	572	121
Massachusetts					
Boston	75	246	321	604	147
Harvard	346	1,896	2,242	666	167
Massachusetts	101	231	332	412	92
Tufts	77	181	258	597	145
Michigan					
Michigan	166	494	660	956	239
Michigan State	254	280	534	433	115
Wayne State	112	239	351	1,019	256
Minnesota					
Mayo	97	704	801	161	40
Minnesota/Duluth	42	2	44	96	0†
Minnesota/Minneapolis	211	698	909	1,066	271
Mississippi					
Mississippi	87	184	271	594	137
Missouri					
Missouri/Columbia	72	193	265	446	113
Missouri/Kansas City	43	375	418	371	84
Saint Louis	122	288	410	611	147
Washington	156	565	721	533	125
Nebraska					
Creighton	52	121	173	459	109
Nebraska	51	226	277	621	136
Nevada					
Nevada	25	37	62	188	42
New Hampshire					
Dartmouth	67	247	314	239	5
New Jersey					
UMDNJ/New Jersey Medical	108	331	439	677	161

† Degree granted by Minnesota/Minneapolis.

School	No. of Full-Time Faculty Members			No. of Medical Students Enrolled	No. of 1983 Graduates
	Basic Science	Clinical Science	Total		
UMDNJ/Rutgers	68	168	236	472	104
New Mexico					
New Mexico	75	188	263	300	69
New York					
Albany	69	147	216	516	128
Albert Einstein	205	881	1,086	724	189
Columbia	124	618	742	605	150
Cornell	103	810	913	435	121
Mount Sinai	176	758	934	462	130
New York	187	453	640	711	171
New York Medical	99	525	624	753	197
Rochester	189	473	662	394	91
SUNY/Buffalo	111	113	224	562	134
SUNY/Downstate	103	267	370	910	218
SUNY/Stony Brook	157	501	658	343	57
SUNY/Upstate	71	210	281	596	151
North Carolina					
Bowman Gray	102	292	394	429	102
Duke	187	593	780	494	121
East Carolina	58	100	158	201	41
North Carolina	221	394	615	639	158
North Dakota					
North Dakota	42	46	88	206	38
Ohio					
Case Western Reserve	145	758	903	603	165
Cincinnati	129	560	689	766	187
Medical College of Ohio	87	136	223	472	47
Northeastern Ohio	75	339	414	340	70
Ohio State	152	259	411	837	131
Wright State	69	109	178	398	95
Oklahoma					
Oklahoma	87	388	475	698	166
Oral Roberts	39	26	65	160	26
Oregon					
Oregon	71	190	261	438	115
Pennsylvania					
Hahnemann	92	272	364	754	178
Jefferson	73	395	468	887	211
Medical College of Pennsylvania	67	200	267	456	120
Pennsylvania	216	685	901	664	148
Pennsylvania State	80	191	271	387	99
Pittsburgh	112	560	672	548	130
Temple	115	276	391	727	180
Puerto Rico					
Caribe/Cayey	25	103	128	284	74
Ponce	23	37	60	177	32
Puerto Rico	76	225	301	579	136
Rhode Island					
Brown	77	235	312	266	63

School	No. of Full-Time Faculty Members			No. of Medical Students Enrolled	No. of 1983 Graduates
	Basic Science	Clinical Science	Total		
South Carolina					
Medical University of South Carolina	148	285	433	638	151
South Carolina	41	59	100	172	33
South Dakota					
South Dakota	35	64	99	232	50
Tennessee					
East Tennessee State	45	86	131	200	26
Meharry	53	99	152	414	109
Tennessee	106	285	391	773	179
Vanderbilt	170	316	486	420	105
Texas					
Baylor	211	717	928	667	170
Texas A&M	64	253	317	134	32
Texas/Dallas	183	415	598	816	204
Texas/Galveston	163	343	506	792	191
Texas/Houston	107	295	402	814	193
Texas/San Antonio	153	344	497	803	191
Texas Tech	83	169	252	371	77
Utah					
Utah	116	358	474	410	107
Vermont					
Vermont	75	160	235	377	93
Virginia					
Eastern Virginia	42	116	158	297	92
Medical College of Virginia	177	404	581	672	161
Virginia	131	341	472	553	132
Washington					
Washington	261	726	987	729	169
West Virginia					
Marshall	30	61	91	158	36
West Virginia	88	208	296	343	80
Wisconsin					
Medical College of Wisconsin	97	459	556	799	193
Wisconsin	99	361	460	653	157
Total	13,589	41,383	54,972	66,886	15,801

SOURCE: AAMC Institutional Profile System.

TABLE 2

Number of Faculty Members, Medical Students, and Graduates in 16 Canadian Medical Schools, 1982–83

School	No. of Full-Time Faculty Members			No. of Medical Students Enrolled	No. of 1983 Graduates
	Basic Science	Clinical Science	Total		
Alberta					
Alberta	98	126	224	471	118
Calgary	68	111	179	216	68
British Columbia					
British Columbia	114	190	304	463	92
Manitoba					
Manitoba	83	210	293	388	104
Newfoundland					
Memorial	49	77	126	224	55
Nova Scotia					
Dalhousie	82	161	243	381	94
Ontario					
McMaster	56	265	321	308	100
Ottawa	58	187	245	336	87
Queen's	76	189	265	310	75
Toronto	209	583	792	988	243
Western Ontario	120	228	348	421	103
Quebec					
Laval	82	79	161	649	155
McGill	107	347	454	631	152
Montreal	97	216	313	998	194
Sherbrooke	43	133	176	408	95
Saskatchewan					
Saskatchewan	72	140	212	300	61
Total	1,414	3,242	4,656	7,492	1,796

SOURCE: Association of Canadian Medical Colleges. *Canadian Medical Education Statistics.* Ottawa, Ontario, Canada: Association of Canadian Medical Colleges, 1983.

TABLE 3

Teaching Responsibilities of U.S. and Canadian Medical School Faculties, 1981–82

Group	Enrollment	
	U.S.	Canada
Medical students	66,484	7,435
Residents	50,381	6,532
Graduate students in basic sciences	16,701	2,068
Clinical fellows	7,123	334
Total	140,689	16,369

SOURCES: AAMC Institutional Profile System.
Association of Canadian Medical Colleges. *Canadian Medical Education Statistics.* Ottawa, Ontario, Canada: Association of Canadian Medical Colleges, 1983.

TABLE 4

Sources of Funding for 127 U.S. Medical Schools, 1981–82

Sources of Funding	Dollars (in millions)
Federal research	1,578
Other federal (nonservice)*	415
State and local government (nonservice)*	1,617
Tuition and student fees	413
Medical services	2,140
Other	1,054
Total	7,217

* Includes indirect cost recoveries.

SOURCE: AAMC Institutional Profile System.

TABLE 5

Research Expenditures in 123 U.S. and 16 Canadian Medical Schools, 1981–82

Dollars (in millions)	No. of Schools	
	U.S.*	Canada
0–2	29	—
2.1–4	17	1
4.1–6	20	1
6.1–8	13	4
8.1–10	7	—
10.1–12	4	3
12.1–14	1	—
14.1–16	5	2
16.1–18	4	2
18.1–20	3	—
20.1–22	3	—
22.1–24	2	—
24.1–26	3	—
26.1–28	6	2
28.1–30	—	1
30.1–32	1	—
32.1–34	1	—
34.1–36	2	—
36.1–38	—	—
38.1–40	1	—
40.1–42	—	—
42.1–44	—	—
44.1–46	—	—
46.1–48	—	—
48.1–50	—	—
50.1–52	1	—
Total 1,162.0	123	16

* Data not available for four of 127 U.S. schools.

SOURCES: AAMC Institutional Profile System. Association of Canadian Medical Colleges. *Canadian Medical Education Statistics.* Ottawa, Ontario, Canada: Association of Canadian Medical Colleges, 1983.

TABLE 6

College Major of Applicants to U.S. Medical Schools, 1983–84

College Major	Total Applicants		Accepted Applicants	
	No.	Percent	No.	Percent
Biological sciences	16,008	45	7,276	42
Physical sciences	7,939	23	4,458	26
Nonscience areas	3,483	10	1,769	10
Nursing, pharmacy, and other health professions	1,306	4	455	3
Mixed disciplines	1,903	5	985	6
Other or no major	4,561	13	2,266	13
Total	35,200	100	17,209	100

SOURCE: Association of American Medical Colleges. *Medical School Admission Requirements, 1985–86, United States and Canada.* Washington, D.C.: Association of American Medical Colleges, 1984.

TABLE 7

Distribution of All Applicants and Accepted Applicants Entering U.S. Medical Schools, 1983–84, According to Grade Point Averages

Grade Point Average	Total Applicants		Accepted Applicants	
	No.	Percent	No.	Percent
4.0	286	<1	246	2
3.30–3.99	17,311	56	11,487	74
3.00–3.29	7,094	23	2,411	15
2.30–2.99	5,810	19	1,279	8
2.00–2.29	475	1	51	<1
0.00–1.99	110	<1	1	<1
Total	31,086*	100	15,475	100

* Number of applicants for whom both GPA and MCAT scores were available.

SOURCE: Association of American Medical Colleges. *Medical School Admission Requirements, 1985–86, United States and Canada.* Washington, D.C.: Association of American Medical Colleges, 1984.

TABLE 8

Colleges and Universities Providing an Average of Five or More Applicants Per Year in 1981, 1982, and 1983 and Matriculants

Range of Applicants	No. of Colleges/ Universities	Applicants		Matriculants	
		No.	Percent	No.	Percent
5–9	230	1,591	4	524	3
10–24	276	4,200	12	1,557	9
25–49	153	5,235	15	2,267	14
50–99	95	6,625	19	3,177	19
100–199	51	7,218	20	3,583	22
200–299	25	5,761	16	3,017	18
300 or more	9	3,197	9	1,832	11
Subtotal	839	33,827	95	15,957	96
Other colleges	858	2,059	5	612	4
Total	1,697	33,886	100	16,569	100

SOURCE: AAMC Division of Student Services.

TABLE 9

Range of Colleges and Universities from Which U.S. Medical Schools Received Matriculants in 1983

Range of Colleges and Universities	No. of Medical Schools*
1–10	1
11–20	5
21–30	19
31–40	14
41–50	21
51–60	26
61–70	16
71–80	10
81–90	11
91–100	1
101–110	2

* Data not available for one of the 127 U.S. medical schools.

SOURCE: AAMC Division of Student Services.

TABLE 10

Range of Weeks in 141 U.S. and Canadian Medical School Preclinical Curricula, 1983–84

Range of Weeks	No. of Schools*
41–50	1
51–60	8
61–70	48
71–80	64
81–90	13
91–100	3
101–110	3
111–120	1

* Data not available for two of the 143 schools.

SOURCE: *1983–84 AAMC Curriculum Directory.*

TABLE 11

Range of Scheduled Hours of Instruction in Preclinical Curricula Devoted to Lectures, Conferences, and Laboratories in U.S. and Canadian Medical Schools, 1983–84*

Lectures		Conferences		Laboratories		All Instruction†	
Range of Hours	No. of Schools	Range of Hours	No. of Schools	Range of Hours	No. of Schools	Range of Hours	No. of Schools
401–500	1	0–50	18	61–120	2	1,000–1,115	1
501–600	2	51–100	17	121–180	2	1,116–1,230	1
601–700	2	101–150	19	181–240	4	1,231–1,345	6
701–800	21	151–200	16	241–300	10	1,346–1,460	5
801–900	25	201–250	19	301–360	21	1,461–1,575	10
901–1,000	27	251–300	16	361–420	17	1,576–1,690	18
1,001–1,100	15	301–350	7	421–480	28	1,691–1,805	23
1,101–1,200	13	351–400	7	481–540	9	1,806–1,920	34
1,201–1,300	10	401–450	1	541–600	10	1,921–2,035	14
1,301–1,400	5	451–500	2	601–660	10	2,036–2,105	8
1,401–1,500	—	501–550	—	661–720	8	2,106–2,220	5
1,501–1,600	1	551–600	1	721–780	2	2,221–2,335	3
1,601–1,700	1	601–650	—	781–840	1	2,336–2,450	5
Total	123		123‡		124		133

* Data not available in each area of or in all instruction for all 143 schools.
† Includes other hours of instruction not devoted to lectures, conferences, or laboratories.
‡ One school schedules 1,642 hours of conferences and no lectures.

SOURCE: *1983–84 AAMC Curriculum Directory.*

TABLE 12

Percent of Total Scheduled Hours of Instruction in the Preclinical Curricula Devoted to Lectures, Conferences, and Laboratories in 124 U.S. and Canadian Medical Schools, 1983–84

Percent of Total Hours	No. of Schools*		
	Lectures	Conferences	Laboratories
0–10	1	68	4
11–20	—	49	28
21–30	—	4	67
31–40	10	3	22
41–50	39	—	3
51–60	45	—	—
61–70	23	—	—
71–80	6	1†	—

* Data not available for 19 of 143 schools.
† One school schedules 1,642 hours of conferences and no lectures.

SOURCE: *1983–84 AAMC Curriculum Directory.*

TABLE 13

Hours of Instruction in Preclinical Disciplines in 143 U.S. and Canadian Medical Schools, 1983–84

Discipline	Range of Hours													Data Not Available	Average Hours	Total Schools
	1–50	51–100	101–150	151–200	201–250	251–300	301–350	351–400	401–450	451–500	501–550	551–600	601–650			
Anatomy	—	—	1	1	2	32	28	23	14	8	4	1	1	28	150	143
Pathology	—	—	12	23	36	16	15	5	2	—	—	—	—	34	233	143
Physiology	—	4	39	51	15	3	2	—	—	—	—	—	—	29	167	143
Microbiology	—	10	41	51	10	2	—	—	—	—	—	—	—	29	155	143
Biochemistry	—	15	62	34	3	1	—	—	—	—	—	—	—	28	137	143
Pharmacology	1	19	65	25	3	—	—	—	—	—	—	—	—	30	129	143
Neurosciences*	5	26	38	5	1	—	—	—	—	—	—	—	—	28	109	103
Behavioral science†	19	51	26	7	2	—	—	—	—	—	—	—	—	28	91	133
Preventive medicine/epidemiology‡	51	24	5	3	—	—	—	—	—	—	—	—	—	28	51	111
Genetics§	62	3	—	—	—	—	—	—	—	—	—	—	—	28	27	93

* Not offered in 40 schools. † Not offered in 10 schools. ‡ Not offered in 32 schools. § Not offered in 50 schools.
SOURCE: *1983–84 AAMC Curriculum Directory.*

TABLE 14

Basic Science Electives Taken by 10,279 Students Graduating from U.S. Medical Schools in 1983

Basic Science Elective	Students Taking Elective*	
	No.	Percent
Anatomy	1,182	11.5
Biochemistry	578	5.6
Genetics	303	2.9
Microbiology	536	5.2
Neurosciences	600	5.8
Pathology	1,663	16.2
Pharmacology	631	6.1
Physiology	588	5.7

* Number and percent are based on students who indicated participation in *at least one* of the listed activities; 202 of the graduates reported taking no elective. SOURCE: 1983 AAMC Graduation Questionnaire.

TABLE 15

Weeks of Required Clerkships in 139 U.S. and Canadian Medical Schools, 1983–84

Discipline	No. of Weeks																							Average Weeks	Total Schools*
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
Medicine	—	—	—	—	—	—	—	12	4	7	8	82	1	5	3	9	3	1	—	2	—	—	1	1	12	139
Surgery	—	—	—	1	—	2	—	19	7	17	5	66	8	5	1	5	—	2	—	—	—	1	—	—	11	139
Pediatrics	—	—	—	4	4	37	10	66	6	7	1	3	1	—	—	—	—	—	—	—	—	—	—	—	8	139
Obstetrics/ gynecology	—	—	—	6	5	57	7	55	5	2	1	1	—	—	—	—	—	—	—	—	—	—	—	—	7	139
Psychiatry	—	1	—	15	11	58	7	46	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	6	139
Family medicine†	—	3	1	23	1	12	1	14	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	5	56
Neurology‡	—	10	7	41	3	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	64

* Data not available for four of 143 schools. † Not offered in 83 schools. ‡ Not offered in 75 schools. SOURCE: *1983–84 AAMC Curriculum Directory.*

TABLE 16

Range of Weeks Available for Electives in Senior Year of 136 U.S. and Canadian Medical Schools, 1983–84

Weeks	No. of Schools*
1–4	1
5–8	8
9–12	12
13–16	15
17–20	14
21–24	26
25–28	16
29–32	22
33–36	10
37–40	8
41–44	3
45–48	1

* Data not available for seven of 143 schools.

SOURCE: *1983–84 AAMC Curriculum Directory.*

TABLE 17

Electives in Clinical Specialties Taken by 10,279 Students Graduating from U.S. Medical Schools in 1983

Clinical Specialties	Students Taking Elective*	
	No.	Percent
Anesthesiology	2,998	29.2
Community medicine	823	8.0
Dermatology	3,160	30.7
Emergency medicine	4,250	41.3
Family medicine	2,398	23.3
Intensive care medicine	2,438	23.7
Internal medicine	3,004	29.2
Cardiology	6,398	62.2
Endocrinology	1,704	16.6
Gastroenterology	1,664	16.2
Hematology	1,503	14.6
Infectious diseases	3,232	31.4
Nephrology	2,741	26.7
Oncology	1,022	9.9
Pulmonary diseases	2,340	22.8
Rheumatology	1,042	10.1
Other internal medicine specialty	701	6.8
Neurology	2,489	24.2
Obstetrics/gynecology	1,643	16.0
Obstetrics/gynecology subspecialty	630	6.1
Ophthalmology	2,131	20.7
Otolaryngology	1,385	13.5
Pediatrics	1,821	17.7
Adolescent medicine	267	2.6
Neonatology	707	6.9
Other pediatric subspecialty	1,344	13.1
Physical medicine and rehabilitation	421	4.1
Preventive medicine	158	1.5
Psychiatry	1,286	12.5
Public health	219	2.1
Radiology	6,562	63.8
General surgery	1,574	15.3
Neurological surgery	510	5.0
Orthopedic surgery	1,922	18.7
Plastic surgery	594	5.8
Thoracic surgery	502	4.9
Urology	868	8.4
Other surgical specialty	864	8.4

* Number and percent are based on students who indicated participation in *at least one* of the listed activities; 202 of the graduates reported taking no elective.

SOURCE: 1983 AAMC Graduation Questionnaire.

TABLE 18

Grading Systems Used in 127 U.S. Medical Schools, 1983–84

Grading System	Basic Sciences		Clinical Sciences		Electives	
	No.	Percent	No.	Percent	No.	Percent
Honors/pass/fail or equivalent	60	47.3	63	50.0	63	50.8
Pass/fail or equivalent	21	16.5	17	13.5	38	30.6
Letter or number grades	46	36.2	46	36.5	23	18.6
Total	127	100.0	126*	100.0	124†	100.0

* Data not available for one of 127 schools.
† Data not available for three of 127 schools.
SOURCE: *1983–84 AAMC Curriculum Directory.*

TABLE 19

Use of National Board of Medical Examiners' Certification Examinations in 127 U.S. Medical Schools, 1983–84

Use by Schools	Part I Examination		Part II Examination	
	No.	Percent	No.	Percent
Optional	29	22.8	36	28.4
Student must record score	35	27.6	41	32.3
Student must record passing total score	59	46.5	—	—
Student must record passing score in each section	3	2.4	—	—
Student must record passing score to graduate	—	—	48	37.8
To determine final course grades	18	14.2	16	12.6

SOURCE: *1983–84 AAMC Curriculum Directory.*

TABLE 20

Specialty Choice of 7,705 Students Graduating from U.S. Medical Schools in 1983

Specialty Choice	Graduates*	
	No.	Percent
Allergy and immunology	12	0.2
Anesthesiology	401	5.2
Critical care	21	0.3
Colon and rectal surgery	3	0.1
Dermatology	92	1.2
Emergency medicine	211	2.7
Family practice	1,368	17.8
Internal medicine	982	12.7
Cardiovascular diseases	110	1.4
Critical care	10	0.1
Endocrinology and metabolism	27	0.3
Gastroenterology	47	0.6
Hematology	19	0.2
Infectious diseases	25	0.3
Medical oncology	25	0.3
Nephrology	12	0.2
Pulmonary diseases	9	0.1
Rheumatology	16	0.2
Neurological surgery	85	1.1
Nuclear medicine	3	0.1
Obstetrics/gynecology	524	6.8
Gynecologic oncology	22	0.3
Maternal and fetal medicine	25	0.3
Reproductive endocrinology	42	0.5
Ophthalmology	296	3.8
Orthopedic surgery	510	6.6
Otolaryngology	180	2.3
Pathology	240	3.1
Pediatrics	501	6.5
Cardiology	19	0.2
Critical care	4	0.1
Endocrinology	2	0.1
Hematology/oncology	21	0.3
Nephrology	2	0.1
Neonatal/perinatal medicine	14	0.2
Physical medicine and rehabilitation	67	0.9
Plastic surgery	92	1.2
Preventive medicine	11	0.1
Psychiatry	327	4.2
Child psychiatry	60	0.8
Neurology	113	1.5
Child neurology	10	0.1
Radiology	24	0.3
Diagnostic radiology	406	5.3
Therapeutic radiology	47	0.6
Surgery	427	5.5
Critical care	4	0.1
Pediatric surgery	27	0.3
Thoracic surgery	72	0.9
Urology	138	1.8
Total	7,705	99.9†

* Graduates who indicated they had definitely decided on certification in a specialty.

† Sum does not equal 100.0 due to rounding.

SOURCE: 1983 AAMC Graduation Questionnaire.

TABLE 21

Career Plans of 10,399 Students Graduating from U.S. Medical Schools in 1983

Career Plans	Graduates	
	No.	Percent
Full-time academic faculty member		
Basic science teaching and research	118	1.1
Clinical science teaching and research	2,446	23.5
Salaried research scientist		
Basic medical sciences	18	0.2
Clinical sciences	47	0.5
Private clinical practitioner		
Alone	411	4.0
In participation with one other physician	1,120	10.8
In a group of three or more physicians	3,684	35.4
Undecided among the other private practice options	1,194	11.5
Salaried clinical practitioner, employed by		
Hospital	673	6.5
Prepaid group clinic	274	2.6
State or federal agency	388	3.7
Administrator—no practice	26	0.2
Total	10,399	100.0

SOURCE: 1983 AAMC Graduation Questionnaire.

TABLE 22

Perceptions of 10,481 Graduates in 1983 of the Time Devoted to Selected Areas of Instruction in U.S. Medical Schools

Instruction Area	Percentage of Graduates on Perception of Time			
	Excessive	Appropriate	Inadequate	No Response
Basic medical sciences information	19.8	73.4	6.1	0.7
Clinical sciences information	1.3	81.2	16.8	0.7
Behavioral sciences information	13.5	62.5	23.1	0.9
Research techniques	4.8	42.8	51.2	1.2
Patient interviewing skills	5.9	82.5	10.9	0.7
Diagnostic skills	1.3	69.6	28.4	0.7
Therapeutic management	1.1	71.9	26.1	0.9
Management of patient's socioeconomic, educational, and emotional problems	4.0	49.4	45.7	0.9
Patient follow-up	0.7	54.8	43.6	0.9
Care of hospitalized patients	6.5	89.3	3.5	0.7
Care of ambulatory patients	1.1	63.1	35.1	0.7
Care of the elderly	1.8	59.4	37.9	0.9
Preventive care	1.6	37.9	59.6	0.9
Public health and community medicine	4.9	46.8	47.1	1.2
Drug effects and clinical pharmacology	2.2	72.3	24.7	0.8
Nutrition	1.2	38.3	59.7	0.8
Medical record-keeping skills	2.2	57.2	39.8	0.8
Practice management skills	0.5	30.0	68.5	1.0
Medical care cost control	0.8	32.8	65.5	0.9
Physician self-evaluation and independent learning skills	0.7	57.3	41.0	1.0
Teamwork with other health professionals	1.7	79.3	18.2	0.8

SOURCE: 1983 AAMC Graduation Questionnaire.

Report of the Working Group On Essential Knowledge

The study of medicine is a cumulative, cyclic process that involves students in continued learning throughout their professional careers. During their medical school years, students must assimilate and integrate a great breadth of information. As they advance from this general phase of learning to the specialized graduate phase, they build upon the knowledge they previously acquired to develop a sophisticated understanding of the complex problems they are expected to solve.

The rapid rate of increase in biomedical knowledge makes it difficult, if not impossible, to determine, once and for all, the essential knowledge* that will equip future physicians to practice medicine. Yet, medical school faculties are responsible for medical student programs and, thus, must formulate criteria for the ongoing determination of the specific knowledge essential for students' general professional education.

Although the faculties of individual medical school departments are responsible for graduate basic science programs, specialty residencies, and fellowships, the collective faculty determines the essential knowledge that medical students are to acquire. Each discipline or specialty rests upon a unique body of knowledge that is an element of that larger body of information defined as essential knowledge. In determining the content and scope of essential knowledge, faculty members must collaborate in their decision making with colleagues from within their respective departments and with colleagues from other departments.

If faculties base the criteria for essential knowledge on the principle that continued learning is necessary for the successful, lifelong practice of medicine, they can more easily control the content and scope of that knowledge at each stage of medical education. Controlling the content of essential knowledge at each stage of medical students' education is not tantamount to diluting the scientific base of medicine. Students must continue to learn scientific concepts and principles throughout their careers. They cannot assimilate all of the scientific knowledge they will need during the preclinical curriculum. That stage of their learning should provide the foundation upon which their future scientific learning can be built, and the content should be limited to providing such a foundation.

In order to keep up with the rapid growth of knowledge in the biomedical sciences, students must learn the skills necessary for continuous, independent learning. To develop this capacity, they must be actively involved in their own education. Faculty members can help students meet these demands by acquiring an awareness of (*a*) the general educational needs of students, and (*b*) the implications that these needs have for the determination of the content and scope of essential knowledge and for the employment of methods for teaching that knowledge:

1. Students need to be active partici-

The Report of the Working Group on Essential Knowledge was submitted to the Project Panel in June 1983.

* The working group defined essential knowledge as that body of information that students need to function successfully and independently at each stage of their education and to continue their development as physicians.

pants in the learning process; thus, faculty members should employ teaching methods that—unlike lectures in which the student is a passive learner—encourage active involvement of students.

2. Students need time to read and to learn in their own way; as a consequence, the faculty should fix scheduled curriculum hours at levels that allow for such independence.

3. Students need opportunities to work cooperatively with other students and faculty members; therefore, faculty members should structure the educational program in ways that provide such opportunities.

The evaluation system is an especially critical, important component of the medical education program. To be effective, evaluation must be consistent with and contribute to the goals of medical education. As with the determination of the scope and content of essential knowledge, each medical school faculty is responsible for setting standards and evaluating the students' attainment of them. Although it is important to assess the level of factual biomedical knowledge students have acquired, evaluations should also encompass their approaches to obtaining and using knowledge.

College Preparation

There were 839 colleges and universities that contributed an average of five or more applicants per year to medical school during the period of 1981, 1982 and 1983. Half of all matriculants to U.S. medical schools for those years came from 81 large institutions, 70 of which have medical schools. The other half of the matriculants for these three years came from 1,238 institutions. A total of 499 colleges supply an average of two or fewer matriculants per year.† The resources and educational emphases of this multitude of institutions are as diverse as their students. The advantages to be derived from this diversity are lost if applicants are required to follow a narrowly defined sequence of college courses.

ADMISSION REQUIREMENTS

The study of medicine should be open to students with diverse sociocultural backgrounds and college majors. Thus, medical school admission requirements should not dictate the educational programs of students aspiring to enter medical school. Medicine is a profession that needs and can accommodate students with diverse talents and interests.

Students do need to have a preparatory science education sufficient to undertake medical school basic science courses. One year of biology, two years of chemistry, and one year of physics are commonly required (Table 1). While achieving these specific requirements will not guarantee that students have gained the knowledge essential for undertaking basic science courses, these requirements are reasonable. However, some medical faculties strongly recommend other college courses (Table 2). Students tend to interpret these courses that are "strongly recommended" as required courses. On the average, each medical school applicant applies to nine schools. To meet the various requirements and recommendations of the many schools to which they may apply, students are all too often left with little opportunity to choose courses in which they might have a particular interest.

The working group recommends that medical school faculties limit admission requirements to those necessary for successful study in their institutions. Faculties should determine these requirements by explicitly delineating the scientific knowledge that is essential for admission to medical school.

† Source: AAMC Division of Student Services.

TABLE 1

Summary of Courses Required for Students Planning To Enter Medical School, 1982–83 (*n* = 126 Schools)

Courses	No. of Schools
Biological Science	
Biology (unspecified)	60
General biology	12
Genetics	6
Zoology	1
General biology or zoology	34
Zoology or botany	1
Biological science	9
Advanced biology	6
Chemistry	
Biochemistry	2
Chemistry (unspecified)	11
General chemistry	32
Inorganic chemistry	75
Organic chemistry	118
Physical chemistry or —quantitative analysis	1
Qualitative analysis	2
Quantitative analysis	8
Humanities	
English	56
Foreign language	9
Humanities (unspecified)	6
English composition	6
English composition and literature	16
Liberal arts	3
Mathematics	
Analytical geometry	1
Calculus	19
College algebra	5
College mathematics	16
Mathematics (unspecified)	10
Trigonometry	2
Statistics	2
Statistics or calculus	1
Physics	
General physics	81
Physics (unspecified)	36
Social and Behavioral Sciences	
Anthropology	3
Behavioral science (unspecified)	10
Psychology	7
Social science	9
Sociology	4
Ethnology	1

Source: *Medical School Admission Requirements 1982–83*. Washington, D.C.: Association of American Medical Colleges, 1981.

TABLE 2

Summary of Courses 'Recommended, Strongly Recommended, Highly Recommended, Urged, Highly Regarded, and Strongly Suggested' for Students Planning To Enter Medical School, 1982–83 (*n* = 126 Schools)

Courses	No. of Schools
Biological Sciences	
Advanced biology	7
Cell biology	4
Comparative vertebrate anatomy	6
Embryology	13
Genetics	14
Histology	1
Microbiology	1
Molecular biology	1
Cell physiology	1
Cell development	1
Developmental biology	2
Physiology	1
Zoology	1
Chemistry	
Advanced chemistry	3
Advanced organic	1
Biochemistry	10
Quantitative or analytical	7
Physical chemistry	16
Mathematics	
Calculus	17
Computer science	1
Statistics	3
Mathematics (unspecified)	9
Humanities	
Art and fine arts	6
Foreign language	5
Spanish	2
English	10
Liberal arts	5
Literature	5
Religion or philosophy	6
Humanities (unspecified)	19
Social and Behavioral Sciences	
Anthropology	3
Behavioral science (unspecified)	7
Economics	2
History	5
Political science	1
Psychology	10
Sociology or social science	22

Source: *Medical School Admission Requirements 1982–83*. Washington, D.C.: Association of American Medical Colleges, 1981.

This recommendation is based upon the conviction that college education should provide students with a broad liberal education and that medical school faculties inhibit the achievement of this goal if they either implicitly or explicitly expect students to follow a narrowly defined sequence of college courses as preparation for medical school.

The objective of a liberal education is to develop a person's ability to approach issues and problems through the rational use of concepts acquired from diverse disciplines. A student cannot achieve this objective by following a single specified sequence of required courses. Thus, widespread preoccupation of students with developing a college record that they consider necessary for admission to medical school runs counter to the goal of a liberal education.

MEDICAL COLLEGE ADMISSION TEST

College and medical school faculties were extensively involved in the 1977 revision of the Medical College Admission Test (1) to identify material taught in commonly required college science courses that would provide sufficient preparation for the study of the basic sciences in medical school. Thus, the present Medical College Admission Test measures the extent to which students have achieved the scientific knowledge to prepare them for successful study in the first two years of medical school.

Experience with the Medical College Admission Test since 1977 has shown that students who meet the minimum science course requirements generally score well enough to be competitive applicants for medical school. Studies of the correlation between students' performance on the Medical College Admission Test and their subsequent achievement in the basic sciences in medical school demonstrate that the examination is a reliable indicator of their achievement (2, 3). The reading analysis, quantitative analysis, and problem-solving sections of the Medical College Admission Test assess skills gained in the study of a variety of disciplines, including mathematics. Faculties can obtain estimates of students' preparation for advanced study from scores on these sections. The rational use of these scores in evaluating students reduces the need to require courses beyond the absolute minimum.

The working group recommends that medical school faculties become familiar with the content of the Medical College Admission Test and base their particular uses of it on a reasonable delineation of the minimum knowledge and intellectual skills necessary to undertake the study of medicine.

GRADES, SCORES, AND SELECTION

Criteria for selection of medical students are established by medical school faculties and, of course, vary. In addition to considering Medical College Admission Test scores, which most medical schools use, they will take into account some or all of the following: the applicant's biographical information, college academic record, personal comments, faculty evaluation, and a personal interview.

The working group recommends that medical school faculties reduce the priority given to high grades and test scores in their selection of students.

Many college students avoid certain courses because they fear that they may not obtain high grades. Both college and medical school faculties foster the belief that admissions committees consider only those students with the highest grades and Medical College Admission Test scores. Yet, research has shown that among medical students who do complete their medical education, the range of college grades and Medical College Admission Test

scores is wide and the college majors are diverse (4). Many medical schools publish the mean grade point average and Medical College Admission Test scores of the class that was selected the previous year (5). Potential applicants are likely to interpret these mean scores as the minimum score requirements for selection.

The working group recommends that medical school faculties review the experiences and the records of their students to establish the range of college grades and Medical College Admission Test scores that is indicative of future academic success. It further recommends that faculties publish that information in lieu of mean scores and inform applicants and their advisers that selection factors other than grades and test scores will be given weight in the selection process.

Admission to medical school is commonly thought to be one of the most competitive challenges college students face. Along with frequent exaggerations of the intensity of this competition, this belief tends to induce students to narrow, rather than broaden, their college education. Convincing college students and faculties that medical school faculties truly want a variety of liberally educated students will require much closer communication between college and medical school faculties and a redefinition of the criteria for selection. Medical school faculty members can take the initiative if they are prepared to make a sustained effort to change these deeply held beliefs. They might begin this effort by communicating with faculties at the 81 universities that provide half of the matriculants, 70 of which have medical schools.

THE BACCALAUREATE DEGREE

College faculties too frequently accede to expectations by both students and professional school faculties that college education should prepare students for advanced study in a specific discipline or profession. As a result, college campuses are rife with premature professionalism. Many students do not view college as the opportunity for acquiring a liberal education and instead see it as the beginning of their professional education. They select their course work to ensure entry into a professional field and to make advanced study easier, at least in the early stages. This premature specialization is the cause of mounting concern about the meaning and purpose of the baccalaureate degree.

The Association of American Colleges is redefining the meaning and purpose of baccalaureate degrees (6). Through this effort, participating college faculties have developed the consensus that college graduates should (*a*) possess far more than mere expertise in some area of concentration; (*b*) be able to communicate effectively through writing and speaking and through applying mathematical reasoning and computations; (*c*) possess knowledge that extends across a broad range of disciplines, including the physical and biological sciences, the humanities, the social sciences, and the fine and performing arts; and (*d*) possess a capacity for analytical, critical, and integrative thinking and for problem definition and solution.

If college faculties define these accomplishments as criteria for granting the baccalaureate degree, they will have to counter the resistance of students and professional school faculty members who believe strongly that college should be a prelude to entry into a profession.

The working group recommends that college faculties establish criteria for the baccalaureate degree that go beyond the demonstration of expertise in some area of concentration and explain to medical school faculties the range of accomplishments required for granting the degree.

Once college faculties follow this rec-

ommendation, two salutary results can be anticipated:

1. College students preparing for the study of medicine will be able to attain a broad liberal education without jeopardizing their chances for admission to medical school.

2. The college faculties will no longer feel constrained to advise students to pursue a series of courses in which they feel candidates must excel to study medicine.

A major obligation of college faculties is to modify their courses as fields advance. For example, organic chemistry, which developed as the carbon chemistry of industrially useful compounds, can now be taught with an emphasis on the carbon chemistry of biological structure and function at the cellular and molecular level.

In summary, college faculties have the authority and responsibility to establish the criteria for granting the baccalaureate degree. Medical school faculties must not usurp this prerogative. They must hold to an absolute minimum course requirements for admission, and they must modify selection criteria that impair opportunities for medical school applicants to obtain a liberal education. College preparation for medicine will then no longer be seen simply as a sequence of prescribed courses.

Medical School

Medical schools have been privileged in their ability to attract intellectually superior students who are capable of learning a large body of knowledge rapidly. For this reason, faculties have not been very selective in teaching medical students.

Fifty years ago the Association of American Medical Colleges Commission on Medical Education stated (7):

> Some of the chief difficulties in medical training arise from efforts to provide instruction in too many subjects in too great detail. These endeavors have created great overloading of the curriculum. The dependence upon sheer memory tends to defeat the development of a scientific attitude and point of view. This makes the application of sound educational methods almost impossible, for the intellectual development of students cannot occur in a breathless, hurried, pressing schedule of assigned exercises.
>
> The methods of presenting subjects, both in the medical sciences and in the clinical departments, are often unsatisfactory. Teachers, graduates, and students agree that topics are presented too frequently from the standpoint of the special interest of the teacher and from the aspect of technical details.

The observations of that commission would be even more applicable to medical education in the 1980s when the rate of increase of relevant biomedical knowledge is much greater than it was then. Medical students protest that specialized faculty members believe they must teach all the latest, detailed information in their fields. The result of this informational transmission is to stifle the students' intellectual development and to threaten their natural curiosity. The intensity of preclinical schedules is evident in most U.S. and Canadian medical school curricula. Lectures predominate as the method of instruction and, as a rule, each course is divided among many lecturers.

FACULTY

A 1982 survey of biochemistry departments conducted by the Association of Medical School Departments of Biochemistry revealed that an average of nine faculty members share major responsibility for the medical student biochemistry course and seven more provide occasional lectures. This division of responsibility for courses among many faculty members is uniquely characteristic of medical schools; in undergraduate colleges and in graduate programs, a single

faculty member generally teaches a course or seminar.

The working group recommends that medical school faculties examine why courses for medical students are taught by so many faculty members and consider whether fewer faculty members would present a more effective program.

One reason why so many faculty members are involved in teaching is that as basic and clinical sciences have become more complex, faculties have become more specialized to pursue research and to provide advanced diagnostic and therapeutic services. With a cadre of subspecialists—all of whom want to participate to a limited degree in teaching medical students—departments have divided the teaching load among these rich sources of talent. Although such a division of labor appears to be both fair and sensible, it is almost impossible to control the degree of detail the subspecialists teach and to ensure that students learn essential principles and concepts. Course directors or coordinators usually are responsible for organizing and scheduling these courses, but, beyond selecting topics to be covered and recruiting the experts to cover them, they have little control over the content of courses.

In required clerkships and clinical electives, students are exposed to many specialized faculty members who are quite willing to teach students about their specialties or subspecialties either on rounds or in conferences. Since the focus of teaching is dependent on the clinical problems present on a service, students are even less likely to learn essential principles and concepts in the clinical sciences during their clerkships.

This multifaculty approach to teaching medical students is so pervasive and so obstructive to the rational delineation of essential knowledge that it is the primary problem that must be solved if medical school is to provide students with a well integrated general professional education. One solution is to restrict the number of faculty members who have both the authority to determine essential knowledge and the responsibility for teaching it.

The working group recommends that the educational program for medical students be delegated to a selected number of major teachers who have the authority to determine and the responsibility to teach the essential knowledge to be presented to students.

Another reason for the limited involvement of so many faculty members in teaching medical students appears to be insufficient recognition for their teaching efforts. They may be eager to have *brief* exposures to students but few are willing to dedicate themselves to the medical student program. Teaching graduate students and residents complements their research and patient care endeavors, while teaching medical students does not. If a restricted number of faculty members are to dedicate themselves to the general professional education of medical students, the opportunity must be deemed a privilege that carries with it personal recognition and control over the resources needed to mount a high quality program. The administrative and fiscal arrangements needed to accomplish this will vary from institution to institution. The responsibility for its accomplishment lies with deans and departmental chairmen.

The working group recommends that faculty members who dedicate themselves to the medical student program be given appropriate personal recognition for this endeavor and support for the resources to mount a high quality program.

INCREASED SCOPE

The expansion of biomedical knowledge and technology and complex changes in the organization and control of the med-

ical service system are altering the physician's role and responsibilities—they require increasing the range of knowledge necessary for the general professional education of the physician. Physicians are far more able to intervene effectively in human illness than were their counterparts of 50 years ago. New knowledge and technology provide diagnostic and therapeutic opportunities to identify, prevent, and cure diseases previously unrecognized or not amenable to treatment. For the most part, these opportunities have been of benefit, but they have also created ethical, administrative, and financial problems that most physicians are not prepared to address.

The working group recommends that the general professional education of physicians include the study of ethical issues, prevention, the organization and administration of the nation's medical service system, and foreseeable changes in the nature of medical practice.

The general professional education of physicians during medical school is necessarily directed toward breadth; in-depth learning in a narrow field is reserved for graduate medical education. However, the development of the study skills and personal discipline needed to pursue independent learning is augmented if students are required to learn about and to report on an area in some depth.

Most faculty members support the involvement of medical students in research. However, the purpose of this involvement in research is not always made clear. Students frequently approach research experience as an opportunity to learn a limited number of experimental techniques. Direct involvement in original laboratory research for the purpose of advancing knowledge is feasible only for students who extend their medical school experience a year or more. On the other hand, research for the purpose of learning how to locate and appraise original articles and write a report can be accomplished in the usual course of medical school. The quality of such an experience should be judged on the process used and the clarity of reporting rather than on the findings.

The working group recommends that faculties require each student to study a subject area in depth and submit a written report some time during medical school. Close association with a faculty member in this enterprise should be ensured.

The foregoing conclusions and recommendations apply across the entire span of medical school. Specific concerns about delineating and teaching essential knowledge during the preclinical and clinical phases are discussed below.

BASIC SCIENCE

Since the publication in 1910 of Abraham Flexner's *Medical Education in the United States and Canada* (8), medical schools have strongly emphasized education in the sciences. Flexner advocated the scientific method for both the basic sciences and clinical education. Use of the scientific method and understanding of the principles of basic science remain an extremely important part of essential knowledge for the medical student.

Delineating the basic science knowledge necessary for patient care has always been difficult; moreover, the knowledge explosion in the sciences has compounded the difficulty. An almost universal specialization and subspecialization of basic scientists and physicians have resulted, and educational programs in residencies and fellowships have expanded. These changes require a new focus for education in the basic sciences in medical schools.

The working group recommends that

those who are responsible for planning the basic sciences program focus on the development by students of a vocabulary and a conceptual framework on which they may base continued learning. These planners must recognize education in medicine as an iterative process; the depth of students' knowledge will grow as they progress through medical school and residency and enter medical practice.

The basic science curriculum in three quarters of the medical schools is based upon separate disciplines. Essential knowledge in each discipline is, for the most part, determined by departmental faculty members who are experts in their fields. When these specialized educators plan their courses they assume that medical students should have the benefit of the knowledge derived from the latest research in their area of interest. While the idea of determining the essential knowledge by experts from a single discipline is appealing and logical, this practice has contributed to teaching excessive detail in the preclinical phase.

The working group recommends that basic science knowledge considered to be essential be determined through interdisciplinary, collaborative decision making among teachers in basic science and clinical disciplines.

Experiments in medical school curriculum design over the last 30 years have produced at least three models in which essential knowledge has been established by collaborative decision making:

1. The first of these was the organ system curriculum developed at the Western Reserve University School of Medicine (9). In that curriculum the basic sciences are conceptualized in their relation to one another and in the interactions manifested in human systems. Faculty members from both basic science and clinical disciplines determine essential knowledge in interdisciplinary subject committees. The basic science curriculum is a responsibility of the faculty as a whole, not of individual departments.

2. Another method and philosophy of teaching the basic sciences were developed at McMaster University in Hamilton, Ontario, Canada, where basic science education is centered around selected clinical problems (10). Working across disciplines in a collaborative decision-making mode, faculty members develop these problems and determine essential knowledge. Each case is chosen to demonstrate principles and concepts from the basic sciences.

3. Collaborative decision making is also used in the development of pathophysiology courses by faculties in 15 U.S. medical schools. In these schools at least 150 hours of course work that involve cooperation between the basic science and clinical faculties demonstrates the application of scientific principles to the understanding of human disease.

Although these models represent fundamental changes in the design of a basic science curriculum, faculties need not establish an organ system or a problem-based curriculum. Basic science courses can be discipline-based, but the knowledge for which students are held responsible should be reviewed by faculty members from other disciplines, both basic and clinical science.

Students repeatedly need to expand and apply their knowledge in the basic sciences as they progress through their clinical education, which is accomplished through the case method of study. This requires that they observe the manifestations of diseases and integrate what they have learned in the basic sciences to understand the mechanisms of disease. Students who have the knowledge and skills to learn independently can proceed on

their own as they study case after case. Students whose initial basic science education fails to equip them with these abilities will not continue to acquire the essential knowledge in the basic sciences they need to stay abreast of new information as they progress through repeated cycles of education.

The working group recommends that teaching methods used in the curriculum foster the development of independent learning skills by medical students.

The Independent Study Program developed at the Ohio State University College of Medicine is a curriculum designed to help medical students become independent learners (11). In the Independent Study Program the students are responsible for determining the pace of their instruction, their immediate learning objectives, and the methods by which to master them. They can select study materials developed by faculties from a variety of sources.

Medical education programs vary a great deal with respect to how many hours of instruction are offered in preclinical curricula, the number of hours students are required to be in class, and the amount of class time that is devoted to lectures. Curricula in which students spend a large proportion of their time in class, especially in lectures, inhibit efforts to learn independently.

The methods faculties use to teach the basic sciences are important in enabling students to develop skills for independent learning: students need time to read, organize, and explore science on their own. They must also have an opportunity to initiate studies rather than simply to respond to requirements for reading and testing. They need time to experiment in how they learn best.

The working group recommends that faculties minimize the amount of time students spend in class and reduce the number of lectures in favor of seminars and laboratories, which encourage interchange of ideas among students and faculty.

CLINICAL SCIENCE

In the clinical sciences, students gain knowledge principally through case studies. Working up and observing patients, students learn directly from the patients. Through conferences and seminars with residents and faculty members, and reading relevant literature, students learn to interpret and integrate what they have learned from patients. For example, students learn about cyanosis by observing cyanotic patients. They learn the probable causes of cyanosis and its manifestations through texts, journal articles, and discussions with teachers. Students also learn to recognize the signs and symptoms of the various causes of cyanosis by examining patients.

On a case-by-case basis, their store of clinical knowledge expands as they rotate through both required and elective clinical clerkships. Because clerkships are provided in a variety of settings and because each patient studied by a clerk is unique, the aggregate learning of the individual student is, to a considerable degree, also unique. Thus, if there is sole dependence on the random exposure of the student to patient cases, the knowledge acquired during clerkships may vary significantly.

The working group recommends that faculty members responsible for the clinical clerkships work together to determine the essential clinical knowledge all students must acquire.

Faculty members from clinical departments who have major teaching responsibility for junior and senior clerks must approach the identification of essential clinical knowledge from three major standpoints: (*a*) the knowledge students must acquire from talking with, observ-

ing, and examining patients; (*b*) the knowledge students must acquire from reading and interacting with faculty members and residents; and (*c*) the knowledge students must acquire from interacting with other health professionals.

Clinical education must also be directed toward developing the fundamental vocabulary and skills needed to explore and solve clinical problems. Inevitably, each student will have more knowledge about one organ system or another, but all should acquire the knowledge that is essential to pursue the solution of clinical problems relative to each system at various stages.

In agreeing on essential clinical knowledge for the general professional education of the physician, faculty members must guard against using a standard appropriate to a resident or fellow. For example, while an internal medicine resident or cardiology fellow would be expected to be able to interpret a phonocardiogram, a junior clerk should study normal and abnormal heart sounds with a stethoscope. Many patients in teaching hospitals have complex problems requiring the use of sophisticated diagnostic and therapeutic technology. Special efforts are required to teach junior clerks the essential knowledge that can be gained through interviews, physical examinations, and relatively simple laboratory procedures. Simply assigning them to the medical service team will not ensure that they acquire basic knowledge for their general professional education.

The working group recommends that faculty members in each medical specialty differentiate knowledge essential for medical students from knowledge essential for residents and fellows. They should examine the content of lectures and conferences to ensure that it meets the standards for knowledge essential to medical students. Residents who teach medical students must understand what knowledge in their specialties is considered essential for students.

Clerkship settings—Hospital services are necessarily organized and staffed to provide diagnostic and therapeutic services to patients who have acute diseases or acute, intercurrent manifestations of chronic diseases. This organizational pattern may not provide the optimal milieu for students to acquire essential clinical knowledge.

Patients rightfully expect that teaching hospitals will provide them with the latest in high-quality services. Clinical services are, therefore, frequently organized around an organ system, such as the cardiovascular system, a disease, such as neoplasia, or a therapeutic technique, such as renal dialysis. If the resources needed for clerkships require that junior clerks be assigned to these services, their opportunity for acquiring essential clinical knowledge may be constrained. Even if assignment to specialized units is not necessary, the spectrum of clinical problems in tertiary care teaching hospitals is often confined to extremely ill patients who have complex problems and who require specialized care and the use of advanced diagnostic and therapeutic techniques. Due to the continuing increase in biomedical knowledge and technology, this trend is irreversible. Hospitalization is costly, and there is a trend toward providing care in ambulatory clinics for patients who have relatively simple clinical problems rather than hospitalizing them. This trend is expected to grow.

The working group recommends that faculties assess whether the teaching hospital provides the optimal environment for junior clerkships and, if it does not, consider alternative settings for teaching.

The ambulatory clinic provides an opportunity in which medical students can

learn a specific body of essential knowledge. This is often the first opportunity many have to take an initial history and perform a physical examination on someone who has not been examined previously. They have a chance to test their skills in history taking and physical examination. The second distinctive feature of this experience is that students learn to recognize disease in earlier stages. Symptoms and signs of disease are often more subtle in ambulatory patients. Third, there are conditions that are almost always seen only in ambulatory patients. Fourth, some diseases, such as hypertension and diabetes, are managed best in the ambulatory setting, since one has to deal with the issues of adherence to a medication or dietary plan. The effect of patients' independent decisions to take drugs or to follow diets cannot be taught in the inpatient setting. Finally, depending on the length or design of their ambulatory experience, students may learn about continuity of care, because they see chronically ill patients at different times in their illness. Thus, they can learn about the importance of patient education in effective, long-term management of medical problems.

The limiting factor for ambulatory clinic clerkships is time. For patients, interviews and examinations by junior clerks require prolonged clinic visits. For physicians, the time required to supervise and teach junior clerks decreases the number of patients they can see and, correspondingly, decreases their productivity and revenue. Solutions to these problems must be sought, for ambulatory clinic clerkships designed for teaching will become a necessity in the future.

The major problems posed by the nontertiary hospital are that principal medical school faculty members are generally not there and the involvement of such a hospital with graduate medical education may be limited or nonexistent. Developing such a hospital into an effective teaching environment requires the dedication of faculty and resources and a willingness on the part of the hospital's administration and medical staff to accept the responsibilities imposed by education. Solving this challenge can be as difficult as solving the time limitation problem for ambulatory clinical teaching.

Program integration—The division of medical curricula into preclinical and clinical phases has the undesirable effect of artificially separating the basic and clinical sciences. In most schools, clinical faculty members participate in planned clinical correlations, introduced during basic science courses to emphasize the relevance of basic science knowledge. Similar planning for reinforcement of basic science learning during the clinical phase is relatively infrequent. In most schools, basic science faculty members are invited to participate in clinical conferences when their specific area of interest corresponds to a case presentation, but these exercises are not usually directed specifically at medical students. Routine involvement of the basic science faculty on clerkship services is not generally practical. Ideally, an educational program should provide an opportunity for students to study the basic sciences after they have completed their required clerkships.

At the Duke University School of Medicine, the year following the required clerkships is elective, and students are required to select a portion of elective courses in the basic sciences. Until recently, Hahnemann University School of Medicine provided a 24-week sequence of system-based, clinical/basic science correlations after students had completed their required clerkships. Albert Einstein College of Medicine has a required eight-week sequence in the fourth year entitled, "Scientific Basis of Clinical Medicine."

These are examples of how a few schools have incorporated the basic science faculty into the clinical phase.

The general experience is that once students enter the clinical phase and become active participants in patient care, it is difficult to redirect their attention toward strengthening their knowledge of essential scientific concepts through formal exercises. This difficulty probably accounts for the relative rarity of programs such as these, but the reluctance of students to return to basic sciences should not deter faculties from trying to integrate basic and clinical science education.

The working group recommends that formal integration of basic science faculties into the clinical phase be accomplished using approaches best suited to the common interests and talents of basic science and clinical faculty members in each school.

Testing and Evaluation

Medical school faculty members depend too heavily on multiple-choice examinations to evaluate students' knowledge. These examinations are powerful determinants of how students interpret the purpose of their studies. The approaches of medical students to learning not only during medical school but also throughout their professional careers will be affected by this early conditioning.

Medical school faculty members generally profess that their goal is to educate students to be critical thinkers, problem solvers, and lifelong learners, but they rely predominantly upon multiple-choice examinations which evaluate students' abilities to memorize and recall detailed facts. Multiple-choice examinations are widely used because they are easy to grade and provide a numerical score. Although they can effectively evaluate the information students have acquired, they are usually not designed to assess how students approach problems and how they apply knowledge.

The working group recommends that medical school faculties use alternative or supplementary methods that evaluate students' approaches to acquiring and using knowledge instead of relying on multiple-choice examinations. It further recommends that faculty members employ evaluation methods that reinforce study approaches compatible with continued, independent learning.

Developing alternative methods for evaluation will place an added burden on faculties. Assessing students' reasoning and problem-solving abilities requires more time and more personal judgment than faculties now use. Although standardized measures of problem-solving ability can be provided by multiple-choice questions to a limited degree, they cannot be relied upon solely.

Because of the additional time and personal effort that alternatives to standardized, multiple-choice examinations require, they will be difficult to implement. Since the early 1950s, when the National Board of Medical Examiners adopted the standardized, multiple-choice question format, many faculties have become dependent upon the Part I and Part II examinations for the certifying sequence, both for program and student evaluation. For the academic year 1983–84, 98 U.S. medical schools reported that they require students to take Part I and 91 require Part II. Of these, 62 require their students to pass Part I and 48 to pass Part II (12). The National Board of Medical Examiners, founded to improve the standards of examinations for medical licensure, has become a national standard for achievement in medical education. Using a national standard is, in itself, not bad. But, these examinations measure performance only within a very narrow range of abilities.

The working group recommends that faculties review their use of the National Board of Medical Examiners certification sequence as a measure of student performance to determine whether or not both the content of the examinations and faculties' ability to evaluate the acquisition of essential knowledge are commensurate with their schools' educational goals.

Conclusion

There is a widely held belief that students at most medical schools are presently overburdened with memorizing a vast body of information. This demand on their intellectual talents inhibits their development of a sound conceptual scientific framework for medicine and their continued independent learning. Although delineating essential knowledge in both basic and clinical sciences is not easily accomplished, it is the major challenge that faculties must meet. Having achieved this goal, faculties can best ensure that students will develop appropriately their fundamental skills, personal qualities, values, and attitudes during their college preparation and general professional education for medicine.

References

1. LITTLEMEYER, M. H. *New MCAT Student Manual.* Washington, D.C.: Association of American Medical Colleges, 1976.
2. ERDMANN, J. B. The Medical College Admission Test and the Selection of Medical Students. *N. Engl. J. Med.*, **310**:386–389, 1984.
3. JONES, R. F., and THOMAE-FORGUES, M. Validity of the MCAT in Predicting Performance in the First Two Years of Medical School. *J. Med. Educ.*, **59**:455–464, 1984.
4. JOHNSON, D. G. *U.S. Medical Students 1950–2000: A Companion Factbook for Physicians in the Making.* Washington, D.C.: Association of American Medical Colleges, 1983.
5. WILSON, V. (Ed.). *Medical School Admission Requirements, 1984–85.* Washington, D.C.: Association of American Medical Colleges, 1983.
6. Association of American Colleges. *A Search for Quality and Coherence in Baccalaureate Education: Project on Redefining the Meaning and Purpose of Baccalaureate Degrees.* Washington, D.C.: Association of American Colleges, 1982.
7. RAPPLEYE, W. C. (Director). *Medical Education: Final Report of the Commission on Medical Education.* New York: Commission on Medical Education, 1932.
8. FLEXNER, A. *Medical Education in the United States and Canada: A Report to the Carnegie Foundation for the Advancement of Teaching.* Bulletin No. 4. Boston, Massachusetts: Updyke, 1910.
9. WILLIAMS, G. *Western Reserve's Experiment in Medical Education and Its Outcome.* New York: Oxford University Press, 1980.
10. BARROWS, H. S., and TAMBLYN, R. M. *Problem-Based Learning: An Approach to Medical Education.* New York: Springer, 1980.
11. TRZEBIATOWSKI, G. L. Independent Study Programs: The State of the Art. In *Recent Trends in Medical Education.* E. F. Purcell (Ed.). New York: Josiah Macy, Jr. Foundation, 1976.
12. WILSON, V. (Ed.). *1983–84 AAMC Curriculum Directory.* Washington, D.C.: Association of American Medical Colleges, 1983.

Members of the Working Group on Essential Knowledge*

JOHN A. GRONVALL, M.D., *chairman*; professor of pathology; and dean, University of Michigan Medical School.†

DEWITT C. BALDWIN, JR., M.D., professor, Department of Psychiatry and Behavioral Sciences and Department of Family and Community Medicine; and assistant dean for rural and community health, University of Nevada School of Medicine.

JO IVEY BOUFFORD, M.D., vice president for medical operations, New York City Health & Hospitals Corporation.†

FAIRFIELD GOODALE, M.D., professor of pathology; and dean and medical director, Medical College of Georgia.

ROBERT KEIMOWITZ, M.D., professor of medicine and health care sciences; and associate dean for student affairs and admissions, George Washington University School of Medicine and Health Sciences.

ROBERTA A. MONSON, M.D., practicing physician; and associate professor of medicine, University of Arkansas College of Medicine.

GEORGE NARDI, M.D., professor of surgery, Harvard Medical School.

ALAN L. PEARLMAN, M.D., professor of neurology and physiology, Washington University School of Medicine.

ROBERT T. SCHIMKE, M.D., professor and chairman, Department of Biological Sciences, Stanford University.†

HARVEY V. SPARKS, M.D., professor and chairman, Department of Physiology, Michigan State University College of Human Medicine.

ARNOLD A. STRASSENBURG, PH.D., professor of physics, State University of New York at Stony Brook.

JAMES V. WARREN, M.D., professor of medicine, Ohio State University College of Medicine.

JOHN C. WESTON, PH.D., professor of biology, Muhlenburg College.

PETER C. WHYBROW, M.D., professor of psychiatry, Dartmouth Medical School.

NORA ZORICH, Medical Scholars Program in Biochemistry, University of Illinois College of Medicine.

Member of the Project Staff

MARTHA R. ANDERSON, PH.D., staff associate, Department of Academic Affairs, Association of American Medical Colleges; special staff to the Working Group on Essential Knowledge.‡

---

* This list shows titles of individuals as they were when they accepted their appointments.

† Also a member of the AAMC Project Panel on the General Professional Education of the Physician and College Preparation for Medicine.

‡ Resigned August 1, 1983.